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WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

**MEMORANDUM**

**DATE:** August 29, 2001

**SUBJECT:** Nectarine Initial Benefits Assessment for Azinphos-methyl and Phosmet

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**SUMMARY**

The major pests of nectarine that can be controlled using azinphos-methyl and phosmet are the oriental fruit moth and peach twig borer. Extension of the REIs for both chemicals would have the greatest impact on IPM and mating disruption programs. Extension of REIs may cause growers to spray earlier and often times unnecessarily as a prophylactic in order to enter the harvest period without the worry of a damaging pest incursion.

**BACKGROUND**

Nectarines (*Prunus persica*) are in the Family Rosaceae and originated in China. The only important difference between the peach and the nectarine is that nectarines have smooth skins and peaches are fuzzy. They come from

identical trees. Nectarines often originate from peach seeds, and peaches may come from nectarine seeds. Botanists are unsure of which originated first. It is impossible to tell which seeds from nectarine trees will produce nectarine bearing trees, so commercial growers graft nectarine producing branches onto peach trees. The branches will continue to produce nectarines.

In appearance, nectarine trees are virtually indistinguishable from peach trees. Tree size and shape, leaves, and even buds look the same. Nectarine fruit, however, is smaller than the peach and smooth skinned (looking more like plums), a golden yellow with large blushes of red. Their yellow flesh has a noticeable pink tinge, with a distinct aroma and a more pronounced flavor than a peach. There are over 100 varieties of nectarine, both freestone and clingstone varieties, the same as for peaches. Freestone flesh separates from the pit easily, while clingstone flesh clings to the pit. Nectarines are hand harvested. The fruit need more delicate handling than peaches as they are bruised easily.

Deep, fine-sandy loam soils with good internal drainage and freedom from alkali or salinity are best for optimum nectarine growth and production. Nectarine trees will not produce commercially acceptable crops under arid conditions without supplemental irrigation water. Many nectarine orchards are furrow or flood-irrigated. No-till cultivation is widely used in California in mature nectarine orchards. This entails a herbicide-treated berm in the tree row with weeds in the row middles being controlled by mowing. Fruit thinning is an annual practice and hand labor is preferred over mechanical or chemical options. Nectarines follow a similar seasonal growth pattern to freestone peaches, with the harvest season extending from late April through late September.

Nitrogen and zinc fertilizers are traditionally applied in the summer and fall following harvest. In some instances nitrogen fertilizer may need to be applied in both spring and late summer. Generally, it is applied in the form of manure (Crop Profile for Nectarines in California, 1999).

The largest production area in the U.S. for nectarines is California (Markle, et al., 1998). Approximately 96% of U.S. nectarine production is in CA with bearing acreage in 1999 of 40,500 acres (Agricultural Chemical Usage 1999 Fruit and Nut Summary, USDA/NASS). Total production yield for nectarines in 1999 was 276,000 tons, of which 258,300 tons were fresh market. Total crop value for U.S. nectarines in 1999 was $113,371,000 (Agricultural Statistics, 2000, USDA/NASS). These data sources do not cover the production of nectarines outside of California.

**USE OF AZINPHOS-METHYL AND PHOSMET ON NECTARINES**

**Azinphos-methyl:** - Azinphos-methyl was applied to 561.5 acres of nectarines in California during 1999 (Summary of Pesticide Use Report Data 1999 Indexed by Chemical, Department of Pesticide Regulation, California Environmental Protection Agency). Azinphos-methyl use on nectarines accounts for only a small percentage (0.42%) of the total state usage for this pesticide. Pests of nectarine that can be controlled using azinphos-methyl include oriental fruit moth, mites, borer, and scales. Nevertheless, azinphos-methyl is only recommended to control oriental fruit moth and peach twig borer (Pests of Peaches, 1998 and 2000, UC Pest Management Guidelines, University of California Statewide IPM Project). However, due to its already longer PHI and REI than phosmet, azinphos-methyl is not used as frequently.

**Phosmet:** - Phosmet is applied to 15,592 acres of nectarines in California, 38.5 percent of total acreage (United States Department of Agriculture, Agricultural Chemical Usage, 1997 Fruits Summary and 1999 Fruit and Nut Summary). Phosmet use in CA on nectarines accounts for 6.1% of total phosmet agricultural use in the state (Summary of Pesticide Use Report Data 1999 Indexed by Chemical, Department of Pesticide Regulation, California Environmental Protection Agency). The major pests of nectarines which are controlled using phosmet include San Jose scale, oriental fruit moth, peach twig borer, and omnivorous leafroller, and katydids. University of California Extension guidelines only suggest using phosmet to control oriental fruit moth, and peach twig borer (post-bloom recommendation only). Nectarines were treated on average 1.2 times per year at a rate of 2.0 lbs. a.i./acre (1.5-3.0 lb.

a.i./acre labeled rate) (Summary of Pesticide Use Report Data 1999 Indexed by Chemical, Department of Pesticide Regulation, California Environmental Protection Agency).

**Target Pests for both Azinphos-methyl and Phosmet:**

**Oriental Fruit Moth**

Oriental fruit moths cause damage by feeding on developing shoots and fruit. They overwinter as mature diapausing larvae inside tightly woven cocoons in protected places on the tree or in the slash and debris near the base of the tree. In early spring, pupation takes place inside the cocoon and adults begin emerging in February or early March in California. Eggs are deposited on newly emerged shoots and the larvae feed in terminals where they complete their development. Feeding on the shoots causes the tip of the shoot to die, causing shoot strikes or flagging. The most severe damage occurs where larvae feed on fruit, causing it to be rated off grade. Larvae bore to the center of the fruit and feed around the pit. Feeding damage may also increase the incidence of fruit decay. After reaching maturity, the larvae exit from the fruit and pupate. There are generally five generations per year in California, though a sixth generation has been observed in years with warm weather in early spring.

In orchards treated with insecticides, shoot strikes is monitored early in the season, especially in April and early May, to assess the development of a potentially damaging problem. If the number of shoot strikes is excessive, insecticides are applied to the second flight in order to reduce oriental fruit moth population levels. In orchards with heavy infestations, additional sprays are needed to prevent fruit damage at harvest.

Fruit is also monitored for the presence of worms. Generally fruit is most heavily attacked in the tops of the trees, so fruit samples should be picked and examined from that area. Although green fruit can be attacked, fruit is most susceptible to attack by oriental fruit moth after color break.

Either bait pans or pheromone traps are used to monitor adult flights. Once the first moth is trapped, degree-days (DD) are accumulated to estimate when the onset of the second flight will occur, usually in May. Once the second flight has started, treatments are applied at 500 to 600 DD to achieve optimum control. Moths are continuously monitored until the crop is harvested in order to detect late-season peaks or migrations of moths from adjacent orchards. If treatments are needed for the third and fourth flights, sprays are made at 400 DD after the start of the flight if the fruit is coloring; or 500 DD if it is not coloring.

**Peach twig borer**

Peach twig borer also damage stone fruits by feeding in shoots and causing shoot strike, or by feeding directly on the fruit. Shoot strike is most severe on vigorous growth of young, developing trees because feeding kills the terminal and can result in undesirable lateral branching. Fruit becomes highly susceptible to attack as it matures (from color break until harvest). Unlike oriental fruit moth, peach twig borer larvae enter fruit at the stem or suture and feed just under the skin. Feeding damage, however, can increase the incidence of fruit decay. There are four generations per year. First generation larvae usually develop in twigs during May and June and give rise to the next flight of moths in late June or early July. Larvae from this and subsequent generations may attack either twigs or fruit.

Applications of insecticide are made immediately if larvae are found entering the fruit. If in-season treatments are necessary, they are timed based on pheromone trap catches, degree-days and shoot strike. Best control is achieved when treatments are applied about 400 DD from the beginning of the flight if fruit is still green; if the fruit has begun to color, however, treatments are at 300 DD. Fields are continuously monitored for number of shoot strikes at the end of each generation. When shoot strike averages three to five strikes per tree, treatment is warranted. (Peach Twig Borer, 2000, UC Pest Management Guidelines, University of California Statewide Integrated Pest Management Project).

**Alternative Pest Control Methods:**

**Oriental Fruit Moth**

Oriental fruit moth control can be achieved with pheromone mating disruptants or insecticides. Alternative insecticides to azinphos-methyl and phosmet to control this pest include methomyl, esfenvalerate, diazinon, and carbaryl. However each of the alternatives have resistance problems or can be disruptive of established IPM programs.

Oriental fruit moth control can be achieved with pheromone dispensers. However, this is the least popular control method mainly due to costs. Mating disruptants are applied just before or at first moth emergence in spring (roughly around March 1). Baits are replaced about every 3 months at a rate of 150 baits per acre. The baits are set up by hand labor. Growers and PCAs are reluctant to use pheromone mating disruption due to the potential for secondary pest outbreaks of oblique banded leafroller (OBLR) and katydids in the absence of broad spectrum insecticides, the increased cost of pheromone application, and the difficulties some growers have experienced with mating disruption failure to suppress reproduction of the target pest. Azinphos-methyl and phosmet are still essential when recovery applications are necessary due to failure of mating disruption programs.

**Peach twig borer**

Peach twig borer can also be controlled during the dormant season in stone fruits with a dormant spray of an organophosphate insecticide plus oil to kill overwintering larvae in the hibernacula. Control during bloom can be achieved with well-timed treatments of *Bacillus thuringiensis* (*Bt*), but this treatment is specific for peach twig borer and will not affect other pests normally controlled by the dormant spray. *Bacillus thuringiensis* is applied to over 35% of the nectarine acres by ground during bloom and prior to harvest. The first spray is applied at pinkbud or first bloom and the second 7-10 days later, but no later than petal fall. However, good coverage is essential. After bloom *Bt* is not effective for peach twig borer. For both types of programs it may be possible to skip the dormant spray in some years if monitoring indicates it isn't necessary or if peach twig borer has not been a problem in your orchard historically. Dormant sprays, bloom sprays with *Bt*, or a mating disruption program are preferred over postbloom sprays because they have less adverse impact on beneficials.

Peach twig borer can also be controlled post-bloom using alternative insecticides. These include chlorpyrifos, diazinon, and carbaryl. Again, each of the alternatives has problems with insect resistance, disruption of IPM programs, or unworkable REIs.

There are about 30 species of natural enemies for the peach twig borer. Among those commonly found in California are the chalcid wasps, *Paralitomastix varicornis* and *Hyperteles lividus*, the native gray ant, *Formica aerata*, and the grain or itch mite, *Pyemotes ventricosus.* In some years these natural enemies destroy a significant portion of peach twig borer larvae, but by themselves they generally do not reduce populations below economically damaging levels.

**Restricted Entry Intervals**

**Azinphos-methyl:**

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|---|---|
| Current label REI's | REI= 14 days hand harvest / hand thin,<br>REI= 2 days for all other activities (3 days in areas with less than 25 inches of rain per year). |
| PHI | 21 days |

**Phosmet:**

| | |
|---|---|
| Current label REIs | REI= 24 hours for all activities (5 day for all activities in CA) |
| Registrant proposed REIs | REI= 7 days with an early entry exception at 3 days for hand thinning |

Please refer to the occupational and residential human health risk assessment on the Agency's website (http://www.epa.gov/pesticides/op) for information concerning the worker risks associated with the restricted entry intervals for this chemical.

**IMPACT OF PROPOSED MITIGATION ON CROP PRODUCTION**:

**Fruit Thinning** – Nectarine trees produce more fruit than can mature to a commercially competitive size on the fresh market. Consequently, fruit must be thinned, whereby excess nectarines are selectively removed, primarily by hand, and on occasion with rubber hoses by tapping the fruit to dislodge them.

Thinning usually begins April 1st and is completed by the middle of May. Occasionally orchards may have to be re-thinned when too much fruit was mistakenly left the first time or when hail damage occurs. On average it takes 103 hours per acre to thin a nectarine orchard at a total labor cost of $828 per acre for July/August harvested varieties (Sample Costs To Establish A Peach/Nectarine Orchard and Produce Peaches/Nectarines, 2000, University of California-Cooperative Extension). Timely thinning is crucial to the production of fresh market fruit with acceptable fruit size.

Phosmet spraying to reduce second generation pest numbers, concurrent with a mating disruption program, occurs in June and July. The proposed REI for thinning would only have an impact in orchards that might require a second thinning as described above. Similarly, the first azinphos-methyl application occurs between May 21 and May 28. This again suggests that hand thinning would only be of concern for orchards that must be re-thinned.

**Pruning** - Nectarines are pruned early spring or late winter. This activity would not be impacted by extension of the REIs for either chemcial.

**Propping** - Limbs are propped to prevent limb breakage through the growing season as fruit size increases. Props are removed at the end of harvest. Extension of azinphos-methyl and phosmet REIs beyond those currently observed in CA could result in production loss as well as tree damage if growers continue to use these two insecticides and do not adequately prop the tree limbs.

**Harvesting** - Nectarines are harvested by hand. Extending the azinphos-methyl and phosmet REIs for hand harvesting to that equal to the PHI should not result in an grower impact.

**Leaf thinning** - Nectarine leaves around the fruit may be removed to enhance color development in the fruit near harvest. However, with newer varieties it is now estimated that only 10% of the acreage requires thinning of leaves. On average it takes 37 hours per acre to leaf thin a nectarine orchard at a labor cost of $300 per acre (Sample Costs to Establish a Peach/Nectarine Orchard and Produce Peaches/Nectarines, 2000, University of California-Cooperative Extension). Leaf thinning occurs within 2 - 3 weeks of harvest. Extended REIs (up to 14 days) would likely have minimal impact on this field activity.

**IPM Disruption** - It is also projected that an extended phosmet REI of 7 days or greater would result in the use of less desirable replacement insecticides, i.e., synthetic pyrethroids that are less compatible with integrated pest management (IPM). The pyrethroids are known to precipitate outbreaks of secondary pests such as San Jose scale and spider mites. Use of the non-OP alternative insecticides would solve the pest problem but would predictably cause a flair up in spider mites within 30-45 days. To avoid catastrophic damage to the orchard resulting from defoliation caused by spider mites, additional pesticide applications would be necessary to control this pest at a cost of $35-80 per acre. This would demand more spraying and would in most cases result in the use of materials that are a greater worker safety risk. In addition, extension of REIs would likely result in prophylactic insecticide application to ensure adequate crop protection prior to harvest.

**Mating Disruption Program** - As some producers have moved away from OPs to softer insecticides, new primary pests have emerged. Katydids, lygus bug, stink bug, and chinch bugs have regained primary pest status in orchards which have moved to softer insecticide programs based on *Bt* and mating disruption. It generally takes 2 years after a grower ceases using OP materials for the population of these pests to build to economic levels.

Many of the new materials are surgical in nature and tend to address only one pest. A mating disruption program in situations where producers have problems with peach twig borer, oriental fruit moth, scale, and obliquebanded leafroller would require the use of 4 different materials and sufficient time to monitor 4 different life cycles, increasing costs sharply in these areas. In this situation the farming operation would likely not see a profit. Conversely, if pest pressures are low and only one or two pests are a threat, mating disruption and application of *Bt* can make good economic sense. For late season varieties which have a history of problems with oriental fruit moth and peach twig borer, phosmet is usually used only to knock down population in the second flight. However, it is important to have phosmet available in the event of a late season incursion where populations surpass maximum threshold. Extension of REIs may cause growers to spray earlier and often times unnecessarily as a prophylactic in order to enter the harvest period without the worry of a damaging pest incursion.